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Water Resources Activities of the U.S. Geological Survey in Ohio

A century of water science

In November 1898, the U.S. Geological Survey (USGS) established five streamflow-gaging stations in Ohio, thus marking the first USGS involvement in water-resources investigations in the State. These stations were established in cooperation with the Ohio Board of Health to provide data needed to safeguard some of the State's first modern drinking-water supplies. More than 100 years later, the USGS is still cooperating with agencies in Ohio to provide water data needed for hazard protection and wise, safe use of the State's water resources. Certain tax-supported agencies—including the U.S. Army Corps of Engineers, the Ohio Department of Natural Resources, the Miami Conservancy District, and the City of Columbus, Water Division—have been partners with the USGS for over 20 years.

From the small beginning of five stations, the hydrologic surveillance network operated by the USGS and cooperating agencies has grown to more than 100 streamflow-gaging stations and more than 100 ground-water observation wells. Added to this network are hundreds of miscellaneous surface- and ground-water sites where short-term data have been collected for special purposes over the years.

A mission-driven program

The work of the USGS in Ohio is driven by the overall mission of the USGS.

The U.S. Geological Survey provides the Nation with reliable, impartial information to describe and understand the Earth. This information is used to

- *minimize loss of life and property from natural disasters;*
- *manage water, biological, energy, and mineral resources;*
- *enhance and protect the quality of life; and*
- *contribute to wise economic and physical development.*

USGS hydrologist collecting ground-water-quality data in an agricultural area in south-central Ohio.

Throughout the Nation, the USGS works to constantly improve the base of knowledge on resource availability and potential geologic hazards. The active involvement of the USGS in Ohio reflects the State's importance in the national water picture, as well as the willingness of state and local agencies to conduct cooperative water-resource investigations.

Of the many natural resources available, water has been the most crucial to Ohio's growth and economic status. Wise use of Ohio water resources for transportation, water supply, and recreation requires the kinds of data that the USGS and its partner agencies collect and analyze. Water is also Ohio's greatest geologic hazard. Nearly every year, floods cost the State thousands or even millions of dollars in damages. Data collected by the USGS have helped reduce flood death toll and damage over the years. Automated streamflow-gaging stations provide early warning of rapid rises on major streams, whereas long-term data collection and postflood investigations at hard-hit sites provides statistical information needed to determine flood probabilities and to help other agencies delineate flood-prone areas.

Program highlights

The following paragraphs highlight some of the most popular and exciting aspects of USGS water-resources activities in Ohio. Details on the rest of the program can be obtained from the selected contacts listed on the back page.

Internet-accessible stream data

During the past few years, a major thrust in upgrading the Ohio stream-gaging network has been the linking of stream-stage sensing devices to satellite transmitters, which ultimately feed data to a USGS World Wide Web site. This enables those with Internet access to view recent stage or streamflow data—normally, within 4 hours of data collection— for more than 100 stream stations in Ohio. Round-the-clock availability of this "real-time" data has been a great benefit for water managers—particularly during floods—but it has also been of benefit for recreationalists who enjoy canoeing, kayaking, and fishing on Ohio's streams.

Historical data are also available by way of the World Wide Web in viewable and downloadable formats.

Flood and drought studies

Although science cannot yet prevent floods and droughts, USGS scientists provide essential information so that water planners and managers can mitigate or prevent some of the damage caused by these hydrologic hazards.

By analyzing long-term streamflow records, USGS scientists have developed statistical techniques for estimating the magnitude and frequency of flooding on streams in urban and rural areas. During floods, USGS field personnel attempt to make streamflow measurements to help refine the statistical data so that extreme flows are adequately accounted for. In situations where flooding was too sudden or too severe for measurement to be made, USGS scientists examine the flooded area after the fact to estimate maximum streamflow. Currently, several flood-related studies are in progress in Ohio, including those on modeling stormwater runoff in Summit County, predicting flood profiles in Findlay, Plain City, and Madison County, and examining effects of high flows on streambed scour around bridge piers.

Droughts, although not as sudden as floods, can be catastrophic to regional economies when prolonged and severe. With regard to drought-related studies, the USGS has an ongoing project to measure low flows of streams to help refine the statistical data base for low flows. The USGS is also in the early phases of a streamwater storage analysis to simulate the effects a 1930's-type drought on Ohio's water supplies.

Floodwaters of Ohio Brush Creek at State Route 125 bridge in Adams County, March 2, 1997 (AP/Wide World photos; reproduced with permission).

Microbiological water-quality research

Because the sanitary quality of water for drinking and recreation is crucial to Ohio and the rest of the Nation, a recent addition to the USGS program of study in Ohio is the research into microbiological aspects of water quality, supported by a laboratory and staff housed in the USGS Columbus, Ohio, office. This laboratory's diverse agenda includes working with the U.S. Environmental Protection Agency and other cooperators to study the microbiological quality of national, state, and local water resources and to develop new methods for early detection of harmful microbes in water.

Surface water and ground water are analyzed for various bacteria such as *Clostridium*, enterococci, and *E. coli*. These "indicator bacteria" have been associated with pathogenic (disease-causing) bacteria responsible for disease outbreaks from fecal contamination.

In addition to bacteria, the laboratory also tests for viruses in water, including coliphage—a virus that infects *E. coli* and is present in fecal-contaminated waters. Other analytical procedures also are used to detect human pathogenic viruses, including a procedure by which the virus is filtered out of a water sample, concentrated, ultracentrifuged, and then analyzed through a DNA-based procedure.

Ground-water studies

The USGS and its cooperators have operated a long-term observation-well network since 1938 and have supplemented the

basic data derived from this network with numerous special studies. The focus of most special studies is to describe regional ground-water characteristics—availability, quality, and flow direction—as background information for water-supply development or ground-water-resource protection. These regional ground-water studies not only help the USGS fill gaps in the national ground-water picture but also provide opportunities for developing and testing new technical and analytical methods for subsurface investigations.

USGS labratory technicians preparing a sample to be analyzed for viruses.

Also part of the USGS ground-water history in Ohio has been a technical and advisory role for the Department of Defense, which continues to seek information on the hydrogeology of military installations and technical solutions for ground-water contamination problems. Currently, ground-water personnel housed in the Columbus office provide technical and programmatic assistance for Air Force bases nationwide.

Recent ground-water studies in Ohio have included (1) investigation of complex ground-water/surface-water interactions along the Great Miami River in Cincinnati, (2) analysis of refrigerant compounds and nuclear-testing byproducts in ground water to estimate ground-water age and flowpaths, and (3) assistance in developing a strategy for evaluating available geologic and water-resource data in the State in support of the U.S. Environmental Protection Agency's Source Water Assessment Program.

National Water-Quality Assessment (NAWQA)

The long-term goals of the NAWQA program are to describe the status and trends in the quality of a large, representative part of the Nation's surface- and ground-water resources and to provide a sound, scientific understanding of the primary factors affecting the quality of these resources. The building blocks of NAWQA are studies of hydrologic systems, called study units, that include parts of most major river basins and aquifer systems.

Two study-unit investigations are operated from the Columbus office. The Lake Erie-Lake St. Clair Basin (LERI) study unit covers 22,300 square miles across parts of five states (see figure). The study unit represents all of the Lake Erie Basin in the United States and is about two-thirds of the total area of the Lake Erie Basin in the United States and Canada.

The Great and Little Miami River Basins (MIAM) study unit covers approximately 7,350 square miles of southwestern Ohio and southeastern Indiana (see below); all streams in the basin ultimately drain into the Ohio River.

The LERI study, established in 1994, has completed its first round of intensive data collection and is currently interpreting and publishing the initial findings. The MIAM study, established in 1997, is currently at the beginning of its intensive data-collection phase.

Recent publications

The following is a selected list of publications produced by the Columbus office since 1998. A full "Bibliography of USGS Publications on Geology and Water in Ohio" can be found by way of the Publications link on the Ohio District World Wide Web page. (See Additional Information section.)

Barton, G.J., Burruss, R.C., and Ryder, R.T., 1998, Water quality in the vicinity of Mosquito Creek Lake, Trumbull County, Ohio, in relation to the chemistry of locally occurring oil, natural gas, and brine: U.S. Geological Survey Water-Resources Investigations Report 98-4180, 46 p.

Casey, G.D., Myers, D.N., Finnegan, D.P., and Wieczorek, M.E., 1998, National Water-Quality Assessment of the Lake Erie-Lake St. Clair Basin, Michigan, Indiana, Ohio, Pennsylvania, and New York— Environmental and hydrologic setting: U.S. Geological Survey Water-Resources Investigations Report 97-4256, 93 p.

Dumouchelle, D.H., 1998a, Ground-water levels and flow directions in the buried- valley aquifer around Dayton, Ohio, September 1993: U.S. Geological Survey Water-Resources Investigations Report 97–4255, 1 pl.

———1998b, Simulation of ground-water flow, Dayton area, southwestern Ohio: U.S. Geological Survey Water-Resources Investigations Report 98-4048, 57 p.

———1999a, Selected ground-water-quality data of the Lockport Dolomite in Darke, Miami, Montgomery, and Preble Counties, Ohio: U.S. Geological Survey Open-File Report 98-655, 13 p.

———1999b, Ground-water levels and flow directions in the glacial sediments and the Lockport Dolomite in southeastern Darke and northeastern Preble Counties, Ohio, July 1999: U.S. Geological Survey Water-Resources Investigations Report 99-4012, 1 pl.

Francy, D.S., and Darner, R.A., 1998, Factors affecting *Escherichia coli* concentrations at Lake Erie public bathing beaches: U.S. Geological Survey Water-Resources Investigations Report 98-4241, 41 p.

Koltun, G.F., and Sherwood, J.M., 1998, Factors related to the joint probability of flooding on paired streams: U.S. Geological Survey Water-Resources Investigations Report 98-4238, 32 p.

Jackson, K.S., Ostheimer, C.J., and Whitehead, M.T., 1998, Hydrologic analyses of selected streams in Erie County, Ohio: U.S. Geological Survey Open-File Report 98-395, 26 p., 1 pl.

Schalk, C.W., 1998, Analysis of the sensitivity of soils to the leaching of agricultural pesticides in Ohio: U.S. Geological Survey Water-Resources Investigations Report 98-4108, 12 p., 1 pl.

Schalk, C.W., Tertuliani, J.S., and Darner, R.A., 1999, Identification of potential wetlands in training areas on Ravenna Army Ammunition Plant, Ohio, and guidelines for their management: U.S. Geological Survey Open-File Report 99-68, 78 p.

Shindel, H.L., Mangus, J.P., and Trimble, L.E., 1998–99, Water resources data, Ohio, v.1 and 2: U.S. Geological Survey Water-Data Reports.

Straub, D.E., 1998, Analysis of the streamflow-gaging station network in Ohio for effectiveness in providing regional streamflow information: U.S. Geological Survey Water-Resources Investigations Report 98-4043, 53 p.

Veley, R.J., Francy, D.S., and Darner, R.A., 1998, How do we determine when the beaches are safe for swimming?: U.S. Geological Survey Fact Sheet FS-112-98, 2 p.

Additional information

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